CLAIM(S):

1. In a modeling machine of the type which builds three-dimensional objects by depositing thermally solidifiable modeling material as a road of material having a height h from an extrusion head that moves at a known speed, the improvement comprising:

a first dispenser carried by the extrusion head and having an inlet for receiving a first thermally solidifiable modeling material and a tip for dispensing the first material in molten form, the tip of the first dispenser having a downward face positioned in approximately a z-plane; and

a second dispenser carried by the extrusion head and having an inlet for receiving a second thermally solidifiable modeling material and a tip for dispensing the second material in molten form, the tip of the second dispenser being maintained in a fixed vertical position relative to the tip of the first dispenser, and having a downward face spaced apart a distance s from the face of the first dispenser and positioned in approximately the same z-plane as the face of the first dispenser;

wherein the distance s is great enough that a road deposited by one of the tips will shrink due to cooling during a minimum transit time Δt between the tips such that the other one of the tips does not drag across and smear the road.

2. The modeling machine of claim 1, wherein the road has a thermal diffusivity K_e, and wherein the minimum transit time is characterized by the relationship $\Delta t = \frac{0.3h^2}{K_e}$.

3. The modeling machine of claim 2, wherein the extrusion head accelerates and decelerates through a path comprising multiple vertices and the tips have a minimum vertex velocity v_{min} and a maximum acceleration a_{max}, and wherein the

spacing s is characterized by the relationship $v_{min}\Delta t + \frac{1}{2}a_{max}\Delta t^2 \le s$.

4. The modeling machine of claim 1, wherein the dispensers are thermally conductive and further comprising:

a thermally conductive body in which the dispensers are carried; and

a means carried by the body for heating the dispensers to a temperature at which the first and second materials are flowable.

5. The modeling machine of claim 4, wherein each of the dispensers comprise an elongated tubular member that terminates in a common nozzle which carries both of the tips.

6. The modeling machine of claim 1, wherein the dispensers are thermally conductive and further comprising:

a thermally conductive body in which the dispensers are carried;

a thermal insulator positioned in the body so as to provide thermal separation between the dispensers;

a means for heating the first dispenser to a temperature at which the first material is flowable; and

a means for heating the second dispenser to a temperature at which the second material is flowable.

7. The modeling machine of claim 6, wherein the thermal insulator comprises ambient air that fills a cavity in the body.

8. The modeling machine of claim 6, wherein the thermal insulator comprises a solid material.

9. The modeling machine of claim 6, wherein the road has a thermal diffusivity K_e, and wherein the minimum transit time is characterized by the

relationship $\Delta t = \dfrac{0.3h^2}{K_e}$.

10. The modeling machine of claim 9, wherein the extrusion head accelerates and decelerates through a path comprising multiple vertices and the tips have a minimum vertex velocity $v_{\min}$ and a maximum acceleration $a_{\max}$, and wherein the spacing s is characterized by the relationship $v_{\min}\Delta t + \frac{1}{2}a_{\max}\Delta t^2 \leq s$.

11. The modeling machine of claim 1, wherein the distance s is at least 0.02 inches.

12. In a modeling machine of the type which builds three-dimensional objects by depositing thermally solidifiable modeling material as a road of material having a height h from an extrusion head that moves at a known speed, the improvement comprising:

a first dispenser carried by the extrusion head and having an inlet for receiving a first thermally solidifiable modeling material and a tip for dispensing the material in molten form, the tip of the first dispenser having a downward face positioned in approximately a z-plane;

a second dispenser carried by the extrusion head and having an inlet for receiving a second thermally solidifiable modeling material and a tip for dispensing the material in molten form, the tip of the second dispenser being maintained in a fixed vertical position relative to the tip of the first dispenser, and having a downward face spaced apart a distance s from the face of the first dispenser and positioned in approximately the same z-plane as the face of the first dispenser; and

a third dispenser carried by the extrusion head and having an inlet for receiving a third thermally solidifiable modeling material and a tip

for dispensing the material in molten form, the tip of the third dispenser being maintained in a fixed vertical position relative to the tips of the first and second dispensers, and having a downward face spaced apart a distance s_1 from the face of the first dispenser and a distance s_2 from the face of the second dispenser and positioned in approximately the same z-plane as the face of the first and second dispensers;

wherein the distances s, s_1 and s_2 are each great enough that a road deposited by one of the three tips will shrink due to cooling in a minimum transit time Δt between the depositing tip and either of the other two tips, such that none of the tips will drag across and smear the road.

13. The modeling machine of claim 12, wherein the road has a thermal diffusivity K_e, and wherein the minimum transit time between any two of the tips is characterized by the relationship $\Delta t = \dfrac{0.3h^2}{K_e}$.

14. The modeling machine of claim 13, wherein the extrusion head accelerates and decelerates through a path comprising multiple vertices and the tips have a minimum velocity at a vertex $v_{\min}$ and a maximum acceleration $a_{\max}$, and wherein the distances s, s_1 and s_2 are characterized by the relationship $v_{\min}\Delta t + \frac{1}{2}a_{\max}\Delta t^2 \leq s,\ s_1$ and s_2.

15. The modeling machine of claim 12, wherein the distances s, s_1 and s_2 are each at least 0.02 inches.

16. For use in a modeling machine of the type which builds three-dimensional objects by depositing thermally solidifiable modeling material as a road of material having a height h from an extrusion head that moves at a known speed, an extrusion

apparatus comprising:

a first dispenser adapted to be carried by the extrusion head and having an inlet for receiving a first thermally solidifiable modeling material and a tip for dispensing the modeling material in molten form, the tip of the first dispenser having a downward face positioned in approximately a z-plane; and

a second dispenser adapted to be carried by the extrusion head and having an inlet for receiving a second thermally solidifiable modeling material and a tip for dispensing the modeling material in molten form, the tip of the second dispenser being maintained in a fixed vertical position relative to the tip of the first dispenser, and having a downward face spaced apart a distance s from the face of the first dispenser and positioned in approximately the same z-plane as the face of the first dispenser;

wherein the distance s is great enough that a road deposited by a leading one of the tips will cool and shrink sufficiently before a trailing one of the tips passes over it, such that the trailing tip does not drag across and smear the road.

17. The extrusion apparatus of claim 16, wherein the road has a thermal diffusivity K_e, the extrusion head accelerates and decelerates through a path comprising multiple vertices, and the tips have a minimum velocity at a vertex v_{min} and a maximum acceleration a_{max}, and further wherein the distance s is characterized by the relationship $v_{min}\Delta t + \frac{1}{2}a_{max}\Delta t^2 \leq s$, s_1 and s_2 where Δt is a minimum transit time between the tips to allow sufficient shrinkage and is given by the equation $\Delta t = \frac{0.3h^2}{K_e}$.

18. The modeling machine of claim 16, wherein the dispensers are thermally conductive and further comprising:

a thermally conductive body in which the dispensers are carried;

a thermal insulator positioned in the body so as to provide thermal separation between the two dispensers;

a means for heating the first dispenser to a temperature at which the first material is flowable; and

a means for heating the second dispenser to a temperature at which the second material is flowable.

19. The modeling machine of claim 16, wherein the distance s is at least 0.02 inches.

20. The extrusion apparatus of claim 16, and further comprising:

a third dispenser adapted to be carried by the extrusion head and having an inlet for receiving a third thermally solidifiable modeling material and a tip for dispensing the material in molten form, the tip of the third dispenser being maintained in a fixed vertical position relative to the tips of the first and second dispensers, and having a downward face spaced apart a distance s_1 from the face of the first dispenser and a distance s_2 from the face of the second dispenser and positioned in approximately the same z-plane as the face of the first and second dispensers;

wherein the distances s, s_1 and s_2 are great enough that a road deposited by any one of the three tips will shrink sufficiently due to cooling before either of the other two tips passes over it that none of the tips will drag across and smear the road.

21. The extrusion apparatus of claim 20, wherein the road has a thermal diffusivity K_e, the extrusion head accelerates and decelerates through a path comprising multiple vertices, and the tips have a minimum velocity at a vertex v_{min}

and a maximum acceleration $a_{\max}$, and further wherein the distances s, s_1 and s_2 are characterized by the relationship $v_{\min}\Delta t + \frac{1}{2}a_{\max}\Delta t^2 \leq s$, s_1 and s_2, , where Δt is a minimum transit time between pairs of the tips to allow sufficient shrinkage and is given by the equation $\Delta t = \frac{0.3h^2}{K_e}$.